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ASKJA, A VOLCANO IN THE INTERIOR OF ICELAND

By W. S. C. RUSSELL

Nowhere else in the world are the two extremes of fire and ice so intimately associated as in Iceland. Volcanic rocks form the greater part of its area; many of these are recent lavas which have been poured forth by its active volcanoes. The higher portions of the island are covered by large ice-fields, great flat carapaces similar to the ice-cap under which Greenland lies buried. The largest of these, the Vatna Jökull, is three times the size of Rhode Island. In some cases an active volcano projects above the ice-cap. When an eruption takes place under these circumstances the effect is catastrophic. The red-hot lava, falling on the ice, causes it to melt suddenly, and a torrent of steaming water, mud, rocks, and pieces of ice is precipitated down the slopes into the valleys below.

Although Hecla is Iceland's best-known volcano, there are many others that deserve attention. Possibly the most interesting of these is Askja, an immense crater in the east-central section of the island. In 1913 the writer, in company with J. C. Angus of York, England, went to Iceland to attempt two things: first, to examine the crater of Askja; and, second, to cross the Sprengisandr, the desolate sand and gravel waste which extends in a northeast-southwest direction as a long band across the interior, from Svartárvatn (Black Lake), the starting point for Askja, to Eystri Pollar, a point north of Hofs Jökull, the most centrally located ice-field of the island, thence through the Illvidrahnúkar (Bad Weather Peaks), along its northern edge, and finally along its western rim southwest cross-country to Reykyavik, the capital. Both objects were successfully accomplished. This paper deals only with our examination of Askja.

Even in Iceland Askja was relatively unknown until 1875, when, on January 4, a tremendous eruption occurred, accompanied by a series of violent earthquakes and great showers of ashes and pumice, which covered a wide extent of country. In February Jón of Vidkaer and another native visited the volcano, which was still in eruption, and ascended the crater rim from the northwest by a pass now called Jónskard. In July an Englishman, W. L. Watts, visited the region from the south.[1] In the summer of 1876 a Danish expedition under the geologist Professor F. Johnstrup made the first scientific examination of the region.[2] On this occasion Lieutenant Caroc of the Danish Navy made a survey of the crater. W. G. Lock, an Englishman, visited Askja in 1878 and 1880 and published two accounts.[3] E. Delmar Morgan, F.R.G.S., in company with Jón of Vidkaer, entered the crater in 1881. He likewise published two accounts of his trip.[4] In recent years the crater has been visited several times by German scientists, principally by Dr. Hans Spethmann and Heinrich Erkes, in 1907 and 1910 by the former and in 1908 and 1910 by the latter. They have published numerous accounts.[5] The work of Erkes was largely confined to an exploration of the Trölladyngja, an ice-capped volcano southwest of Askja, but he obtained some excellent photographs of the shore of Askja's crater lake, Knebelsvatn. He named the lake ''Knebelsee'' in honor of von Knebel, who, in company with Rudloff, lost his life in the lake in 1907.[6] The Icelandic termination *vatn* is preferable.

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[1] Journey across the Vatna Jökull in the Summer of 1875, *Journ. Royal Geogr. Soc.*, Vol. 46, 1876, pp. 1-10.

[2] Om dei Aaret 1875 forefaldne vulkanske Udbrud paa Island, tilligemed nogle indledende geografiske Bemaerkniger, *Geografisk Tidskrift*, Vol. 1, 1877, pp. 50-66.

Extending north, west, and south of Askja lies a large lava-field, the Ódádahraun, or ''Evil-Deed Lava.'' It is so named because of the havoc wrought in the valleys and the extensive plains which the lava from Askja has penetrated. These lava sheets lie at an altitude of about 1,500 feet and consist of numberless lava flows, some of them thousands of years old, clothed with lichen, while others are of recent origin. The great lava fields of the Dýngjufjöll (Bower Mountains) on the north have flowed from rifts which have opened again and again in the mountain wall that circles Askja and forms the real crater rim.

The lava areas to the south and southwest of Askja, according to Watts, came from the craters of the Tröllandyngja, and Erkes in his report is inclined to support the statement of Watts. The writer, however, is of the opinion that the lava, covering hundreds of square miles in this section of Iceland, comes principally from Askja. Doubtless, in early times, before the base of Askja was buttressed as it is today by the overflowed lava, frequent eruptions occurred in the outlying ridges, which give evidence of the tremendous rifting in bygone years.

It is impossible to depict the utter desolation, the terrible tangle of stiffened lava billows, the crumpled ridges and blister caves that extend for miles in all directions from Askja. It is as if the lava, as liquid as the sea and rolling in mighty waves whose crests were slashed by winds of hurricane velocity, had, when in this condition, immediately solidified on the surface. Following this the pent-up gases, combined with the intense

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[3] Askja, Iceland's Largest Volcano, With a Description of the Great Lava Desert in the Interior and a Chapter on the Genesis of the Island, Charlton (Kent), 1881.

Askja, The Largest Volcano of Iceland, With a Short Description of the Ódádahraun, *Proc. Royal Geogr. Soc.*, Vol. 3, 1881, pp. 471-483.

[4] Excursion to Askja, August,1881, *Proc. Royal Geogr. Soc.*, Vol. 4, 1882, pp. 140-146.

Chapter IV in J. Coles' "Summer Travelling in Iceland," London, 1882.

[5] See principally H. Spethmann: Islands grösster Vulkan, die Dyngjufjöll mit der Askja, Leipzig, 1913 (with bibliography, pp. 23-25).

H. Erkes: Meine vierte Islandreise, Sommer, 1910, *Globus*, Vol. 98, 1910, pp. 309-311.

[6] See especially "Island: Eine naturwissenschaftliche Studie," a posthumous work of von Knebel, completed and edited by Dr. Hans Reck, Stuttgart, 1912, reference on pp. 198-200; also Spethmann, *op. cit.*, pp. 12-20.

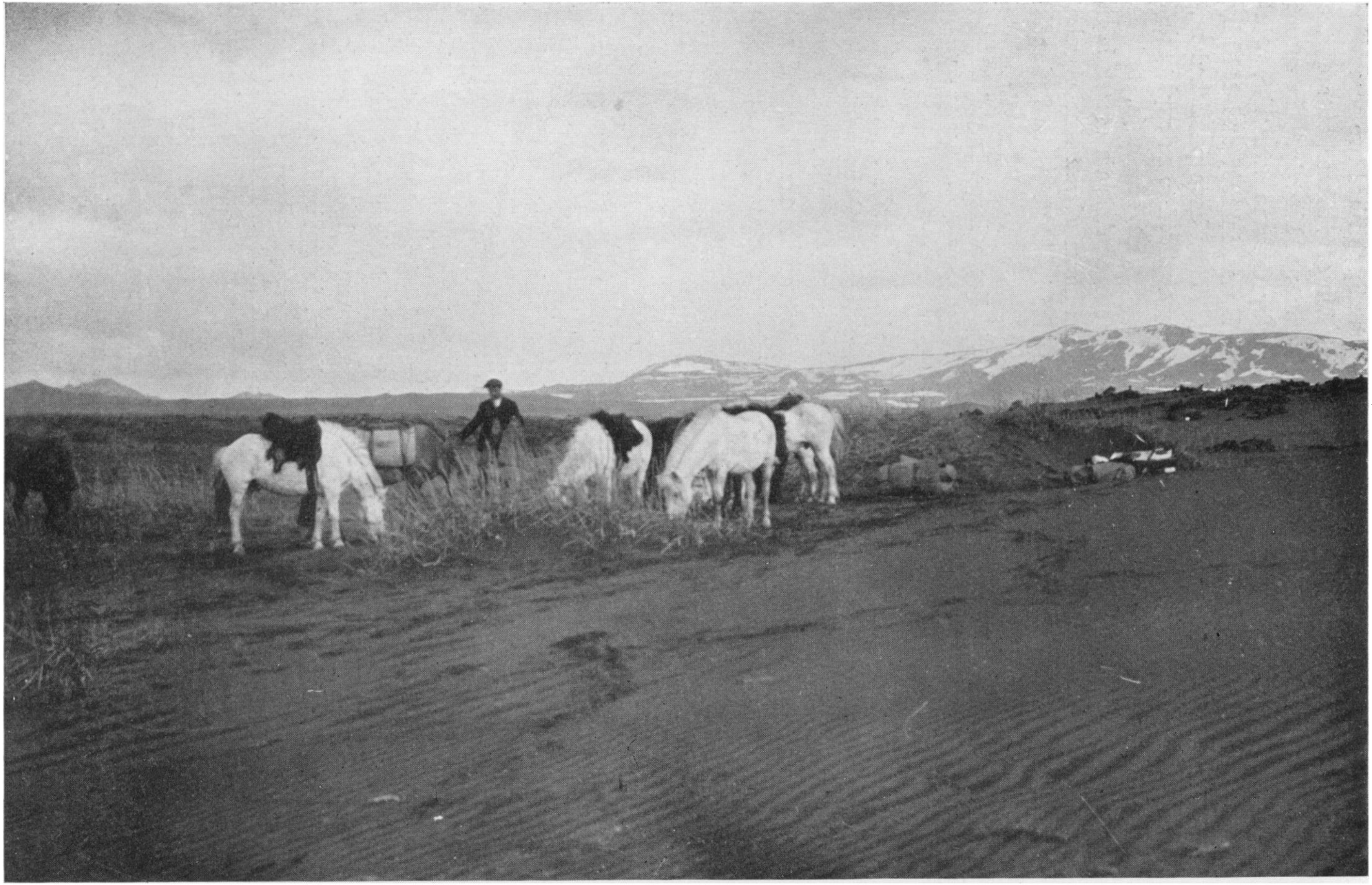

FIG. 1—On the way to Askja: Patches of sand-reed, the only vegetation met with in this lava waste of east-central Iceland. The ponies are eating hay which was brought from a farm at the starting point of the journey. The Dyngjufjöll, the volcanic massif within which lies the crater of Askja itself, is seen in the distance at the right. The material in the foreground is volcanic sand: note the wind ripples. (All the photographs in this article were taken by the author.)

subheat, burst the thin crust in myriads of places with secondary outpourings. It is a chaos beyond the description of the wildest imagination. Here and there great depressions, like mammoth bowls, occur; again tremendous blisters heaved up by internal pressure cover the area. Subsequent shrinkage and cracking have transformed many of the domes into weird caves, places where witches hung their devil's cauldron and brewed their fiendish potions. But the pots are ruined and only the crumpled and contorted fragments are left to ensnare the feet of the orthodox traveler.

We arrived at Svartárvatn (Black Lake) on July 13, 1913, and immediately repacked our cases, taking only such instruments and supplies as were necessary for the expedition. The farmer Thordur Floventsson accompanied us to act as guide across the intervening lava. We left the farm at noon of the same day and followed the Sudrá about four miles to its springs at the edge of the Ódádahraun. This water undoubtedly flows for a long distance under the lava, coming down from the melting snows of the upper slopes of the Dýngjufjöll. The entrance to the lava sheet is abrupt, and the line between the volcanic ashes and lava is nearly straight for several miles. Hour after hour we picked our toilsome way over horrent and bristling ridges, now descending into the valleys, where the ashes treacherously concealed the cracks and blisters in the lava sheets; again climbing by painful steps to the summit of the ridges only to see beyond us the snow slopes of the Bower Mountains, apparently no nearer than an hour before. We emerged from the lava as abruptly as we entered it and came upon ridges of wind-driven volcanic ashes, arranged in heaps like the great wastes of the Sahara, but, unlike the Sahara, capped with snow. The vast hollows were filled with ponds and the ravines echoed with boisterous torrents.

We rested an hour in the shelter of an ash hill to partake of our evening meal and feed the ponies with hay which we had brought from the farm. We cached the remainder of the hay for the ponies on their return.

Over ridges of rubble, across valleys of sand, wind-driven and water-shifted, up, up, we climbed till we reached the snow field, passing Lockstindur and its bristling masses of tufa on the left. We turned the ponies directly into Jónskard, sharply outlined against the evening sky. In most places the snow was sufficiently hard for the ponies to carry us with little slumping. Now and then treacherous spots let the ponies through and the rider, of necessity, was forced into the slush to extricate the struggling horse.

About 9.30 in the evening we came to the most rugged portion of the climb. Indeed, it seemed most difficult because we were somewhat exhausted with our long hours crossing the lava. We dismounted and led the riding ponies in single file, while the pack horses, with the tent and supplies, were driven in advance. We made a zigzag trail up the cinder ridge. Oftentimes masses of débris gave way and went scurrying into the snow ravines below.

As we turned the corner of a massive ridge, I said to the Icelander, "John's Pass?" "Yes, yes, John's Pass," he replied. "Nay, nay," said I, "John's Mountain." He laughed, shook his head, and we proceeded.

At 11.30 our hard work was over and we entered Jónskard upon the firm snow. At midnight we gained the summit. At this altitude and elevation the sun gave ample light, so that the shadows of the mountain were cleancut across many miles of snow and sand.

Midnight! I shall never forget it! Standing at the summit of Jónskard, I looked toward the north. The lake glimmered in the midnight light and the round dome of Sellandafjall concealed the midnight sun, but broad streams of sunlight radiated from either side of the summit and a flood of sunlight bathed the summit of Bláfell. Between us and these mountains were many miles of lava desert. To the east and north rose prominently the snow-capped volcanoes, Búrfell, Kerling, and, farther east, the unscaled summit of Herdubreid, nearly 5,000 feet in altitude. On our immediate right and left the tufa ridges of Askja's crater rose hundreds of feet above the pass. Wild and magnificent as is the northern view, it is not to be compared with the beauty of the gem in its lovely setting that lay in the mighty crater at our feet. The initial task was completed. The object of our expedition, the survey of the crater, was to begin. A depression at least four miles across and circled with a chain of mountains gives the crater the name Askja, or the Bowl.

The eye was led directly across the blackened snow fields to the jewel, Knebelsvatn, a lake in the mammoth tube of the crater near the southeast wall. Its color is a deep turquoise of a depth and brilliance such as I had never seen in the stone itself, so clear, so quiet, and serene in the midnight silence. The blue deepened here and there by the shadows of the overhanging crags. The smoking solfatara on the eastern shore was sending its columns of steam and gases above the crater wall, glistening in the midnight sunshine, reminding us forcibly of that other pillar of cloud and the column of fire which in ancient days separated the Chosen People from the Egyptian host. For fifteen minutes we stood beside the ponies and drank in the wondrous beauty of this scene and received the impression of its terrible desolation. No sound was heard save here and there the rolling stones down the crater slopes started by an occasional earth tremor, which echoed forcibly from the past and impressed us with the fact that, if the Plutonic giant were sleeping, his slumbers were not peaceful.

Tired and hungry we pitched the tent on the narrow edge of the black and red cinder mound (15 on the map, Fig. 6) between two ice masses, the one at our back affording some shelter from the wind. It was with a tinge of sadness that we said goodby to the farmer as he started on his lonesome journey of twelve hours down the mountain to his home. He was an old man, yet strong and vigorous, whose hospitality we had thoroughly enjoyed at Svartákot and whose ready wit and store of information, in his broken English, beguiled the weary hours of our climb. As the ponies clattered up the pass, we crawled into the sleeping bags and slept the clock round.

On July 14 at noon we began our examination of the crater. Our first step was to measure a base line of 600 feet on the hard snow above the tent. From each end of this line we took a round of sights to each of the prominences in the entire circle of the crater. We made a series of photographs, so that when placed side by side we had a complete panorama of the crater floor, the encircling mountain, and the lake. From our data we hoped to be able accurately to construct on paper the entire crater by triangulation. When we discovered that the magnetic variation in a distance of 600 feet was 14°, we found on working out our figures that the results were inaccurate. Yet they were near enough for a reconstruction which would convey an accurate idea of the physiographical features.

On the following day we made a journey across the crater floor to Knebelsvatn. From our tent it did not appear difficult, but when we found the floor rifted and cracked in all directions, with great areas covered with snow and arching the cracks in a treacherous fashion, the task proved most difficult and the journey required nearly four hours. Oftentimes we waded in the melting snow to our knees and sometimes to our hips. We encountered many ridges of tufa which required long detours of difficult climbing. When within half a mile of the lake, we passed out of the snow into the pumice sand, and here the cracks were more numerous and dangerous. In many places the crevasses are arched with frozen snow and pumice. Accidentally I broke into one of these, and had it not been for the 150 feet of rope with which the three members were tied 75 feet apart I would never have returned to write this account. We tied a rock on the end of our rope and lowered it into this crack its entire length without touching bottom. It has never been known for certain how Knebel and Rudloff lost their lives in the crater, but it was our belief that they fell into some such crevasse as this. The story current in Europe is that they tried to navigate the lake in a rubber boat, that the hot water melted the boat and they were drowned in the scalding water. If the water was hot enough for this we cannot believe that two men of their judgment would attempt such a feat.

With difficulty we descended the southern edge of the escarpment to the water's edge and found the temperature of the water to be 7½° C. On the eastern edge the water boils where it comes in contact with the solfatara, and steam is constantly rising. Our engineering aneroid gave the elevation of the surface of the lake as 3,317 feet above the sea. This figure is of scientific value because a dispute has been current in Europe

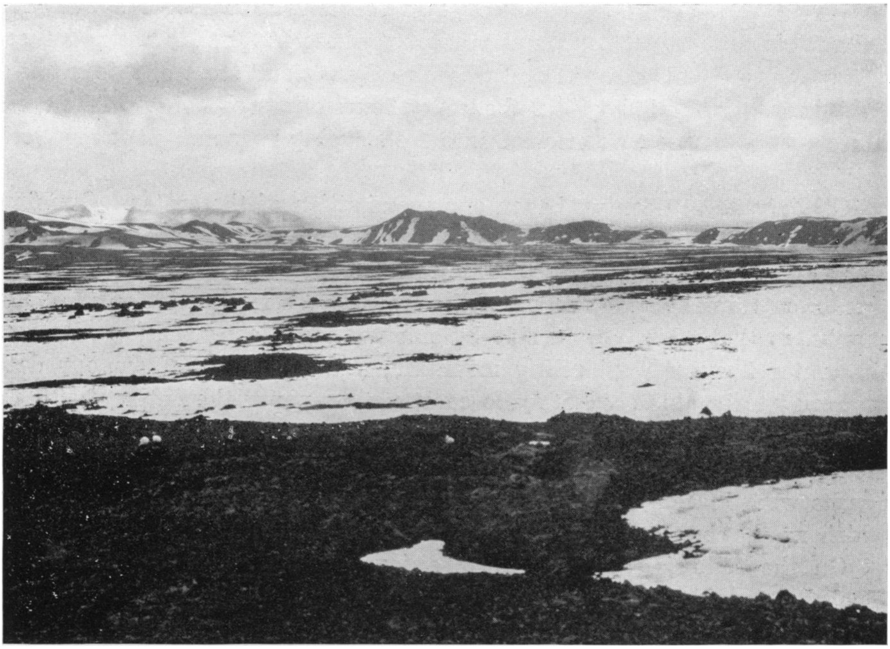

FIG. 2.

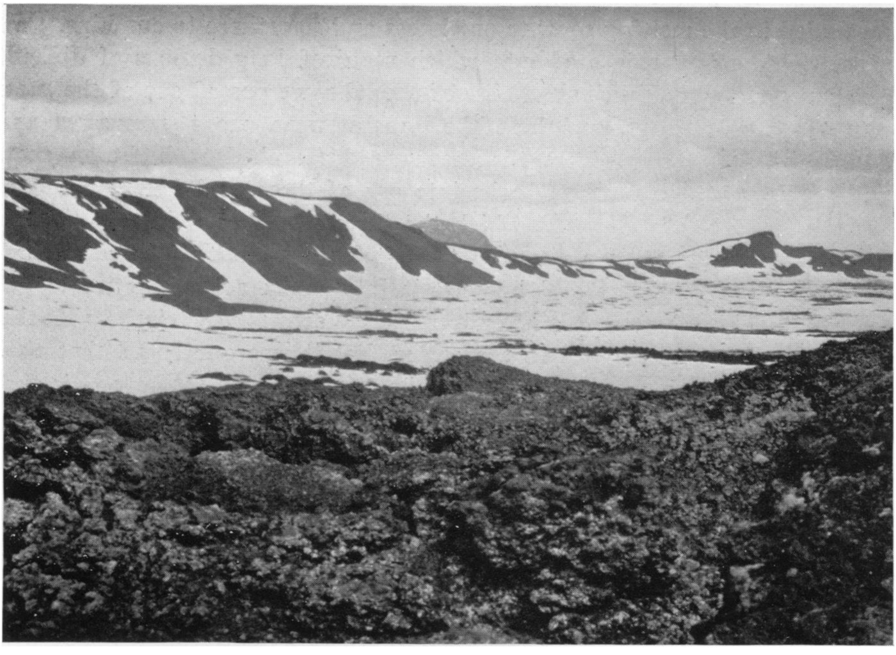

FIG. 3.

FIG. 2—Askja: General view from the cinder ridge (15 on the map, Fig. 6) southeast across the crater floor. Thorodssenstindur (11 on the map, Fig. 6) in the middle distance.

FIG. 3—View northward across the crater floor. Herdubreid (direction of point 14 on the map, Fig. 6) in the distant center, outside the crater rim.

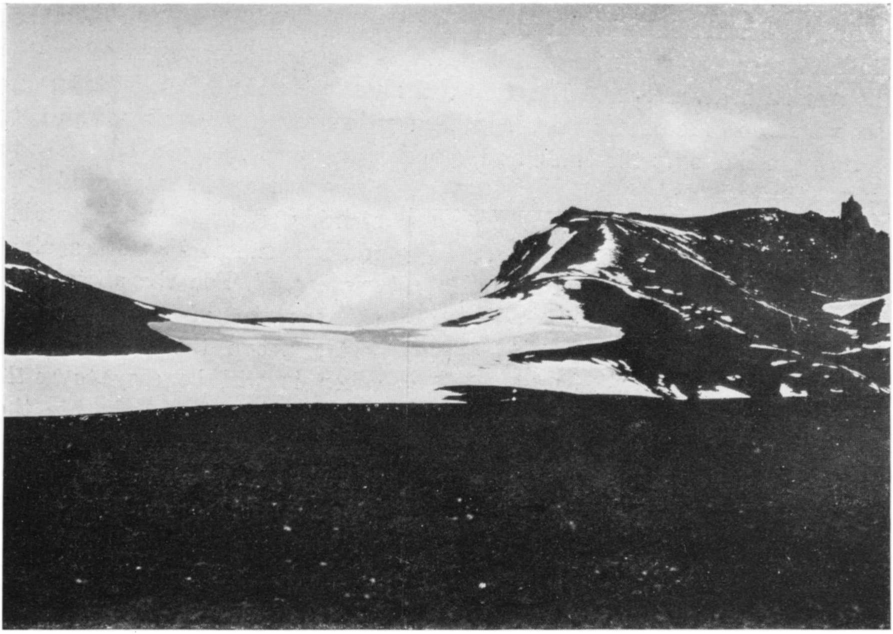

FIG. 4.

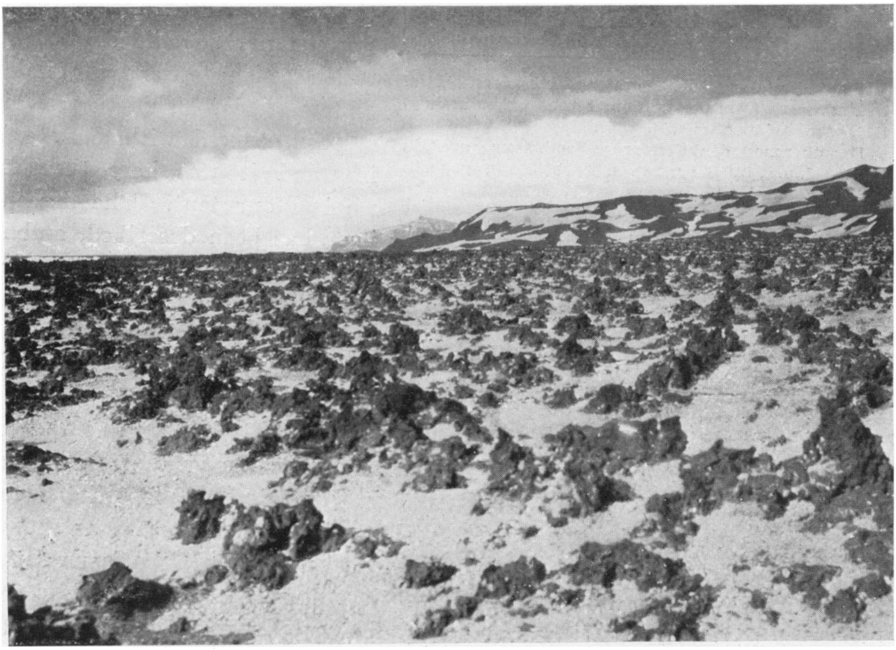

FIG. 5.

FIG. 4—Jónskard, the depression in the northwestern section of the crater wall, viewed from the cinder ridge inside the crater. Erkesfell at right (16 on the map, Fig. 6).

FIG. 5—The character of the crater floor from the foot of the cinder ridge. Cracks and basins encrusted with snow and pumice sand. In the left background, lava stream (8 on Fig. 6).

as to whether the lake has been rising or falling. Dr. Erkes told me that the first piece of work he would do in Askja would be to estimate the altitude on a given date. Heretofore the surface of the lake between the escarpment of the crater floor has been either estimated or measured by throwing a line over the cliffs, and, since no one erected a pile of stones to show where he measured the altitude, it has been impossible to check one man's work against another. When the altitude of the surface of this sheet of water above the sea is again taken it will be easy to settle the question as to whether the lake is rising or subsiding.

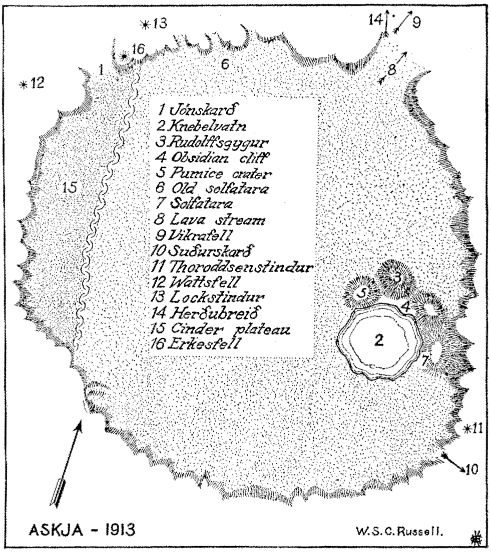

FIG. 6—Sketch-map of the crater of Askja, east-central Iceland, made from observations by the writer in July, 1913. Approximate scale, 1:175,000.

For other maps of the crater see Spethmann, *op. cit.* in footnote 5, p. 2, 1:200,000, and von Knebel-Reck, *op. cit.* in footnote 6, p. 196, 1:300,000.

On the accompanying map (Fig. 6) the numbered places within the crater wall are definitely located by triangulation. The direction of the prominent mountains without the crater is indicated by arrows. Jónskard (1) is a depression in the northwestern part of the crater rim which leads into the great cinder plateau (15). This plateau is largely covered with snow and ice, and it was here that we pitched our tent. The descent into the crater floor is precipitous. This floor has been described, and it remains to state that the pumice areas are just west of Knebelsvatn (2). The greatest solfatara (7) is east of the lake at the foot of the precipitous cliffs. The north shore of the lake is marked by steep and irregular obsidian cliffs (4). The crater from which the last pumice was ejected is at (5). The more recent outpouring of lava escaped from the crater in a northerly direction (8).

A sketch made by Lieutenant Caroc is an accurate view of the crater as it appears when seen from Jónskard, but if one descends into the crater and reaches the southern edge of the lake the crater appears as shown on the southern portion of the accompanying map. In Caroc's map the lake is farther to the north, and the south wall of the crater borders the lake, which is incorrect. The number of photographs which we made from all portions of the crater floor establishes the correctness of this statement. For instance, Herdubreid (14) is not visible from Jónskard (1) but from the western shore of the lake. This ice-capped dome shows prominently in the photographs in the direction of the arrow (14). Vikrafell (9) shows from the cinder slope at (15). Wattsfell (12) and Lockstindur (13) are prominent tufa cones rising on either side of Jónskard outside the crater wall. Thoroddsenstindur (11) is a sharp peak surmounting a long ridge just outside the true crater rim in the direction of Vatna Jökull. The name was assigned to this peak by Dr. Erkes. Beyond this mountain the ice cliffs of that portion of Vatna Jökull, known as Bruar Jökull, rise high above the lava field. The cliffs on the northeastern side of Jónskard rise nearly 1,000 feet above the pass, and I have named this mountain ''Erkesfell'' (16) in honor of a gentleman who has done much valuable topographical work in the interior of Iceland.

The topographical features of Askja have been briefly outlined in this paper. Much work remains to be done, not only in the crater but in the practically unexplored and unmapped territory around the Bower Mountains, especially between Vatna Jökull and Askja and the extensive areas directly north and eastward.